Space Weather Technical Forecast

Issued on Sunday 9 February 2025 at 12:58 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: M-class flares (R1-R2; Minor-Moderate radio blackouts) likely throughout. G1/Minor storms likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with only C-class flares in the last 24 hours.

There are currently ten active regions on the Earth-facing disc. A cluster of entwined regions exists in the northwest quadrant, containing AR3976, AR3978, AR3981 and AR3984. These four regions continue to mostly show slow decay in recent hours. The largest and most complex region is AR3981 with the recent loss of its remaining delta spot in the intermediate portion. Further reorganisation of the intermediate spots was observed. The other regions within this cluster are close together and rather ill-defined with respect to their boundaries and appear magnetically interconnected. Remaining regions on the disc are relatively small and simple. The new unnumbered region continues to rotate into view from the northeast limb and visible plage to on the southeast limb indicating further regions likely to rotate on to the Earth-facing disc in the next 24-48 hours.

A faint CME was visible leaving the Sun around 09/1130 UTC from the southeastern limb, currently awaiting further imagery for analysis but it is initially believed to be passing behind Earths orbit.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, were initially at slow-ambient levels around 350km/s but have begun to increase to slightly elevated levels, currently sitting around 410km/s. The Interplanetary Magnetic Field, Bt, was initially moderate, around 10nT with a steady rising trend to high, peaking at 22nT at 09/1136 UTC. The north-south component, Bz, was initially negative, with a low of -8nT before a steady trend to largely moderately positive Bz, with the peak of 16nT at 09/1054 UTC. The phi angle was initially positive (away from the Sun) but began to change to negative (towards the Sun) from around 09/0550 UTC, due to an initial connection to CH13/-. Geomagnetic activity was mainly Quiet (Kp 0-2) with a few brief Unsettled (Kp3) intervals at the start of the period.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at mostly background levels. The associated 24-hour fluence persisted below the Active threshold on a slightly declining trend, recording 1.86e6 integrated pfu at 09/0000UTC.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate solar activity is likely with a slight chance of an X-class flare, primarily from the cluster of regions in the northwest, currently the greatest risk is from AR3981, especially during the next couple of days, before it rotates over the northwest limb, soon to be replaced by further sunspots rotating over the eastern limb.

Solar Wind / Geomagnetic Activity: There is a slight chance of two glancing coronal mass ejections during Days 2 or 3 (10-11 Feb). Solar wind speeds are expected increase in the next 24 hours or so due to a connection to a HSS from CH13/-, as a result, solar winds are likely to become elevated to strong. A subsequent connection to CH14/- is then forecast to follow from Day 3 (11 Feb) onwards.

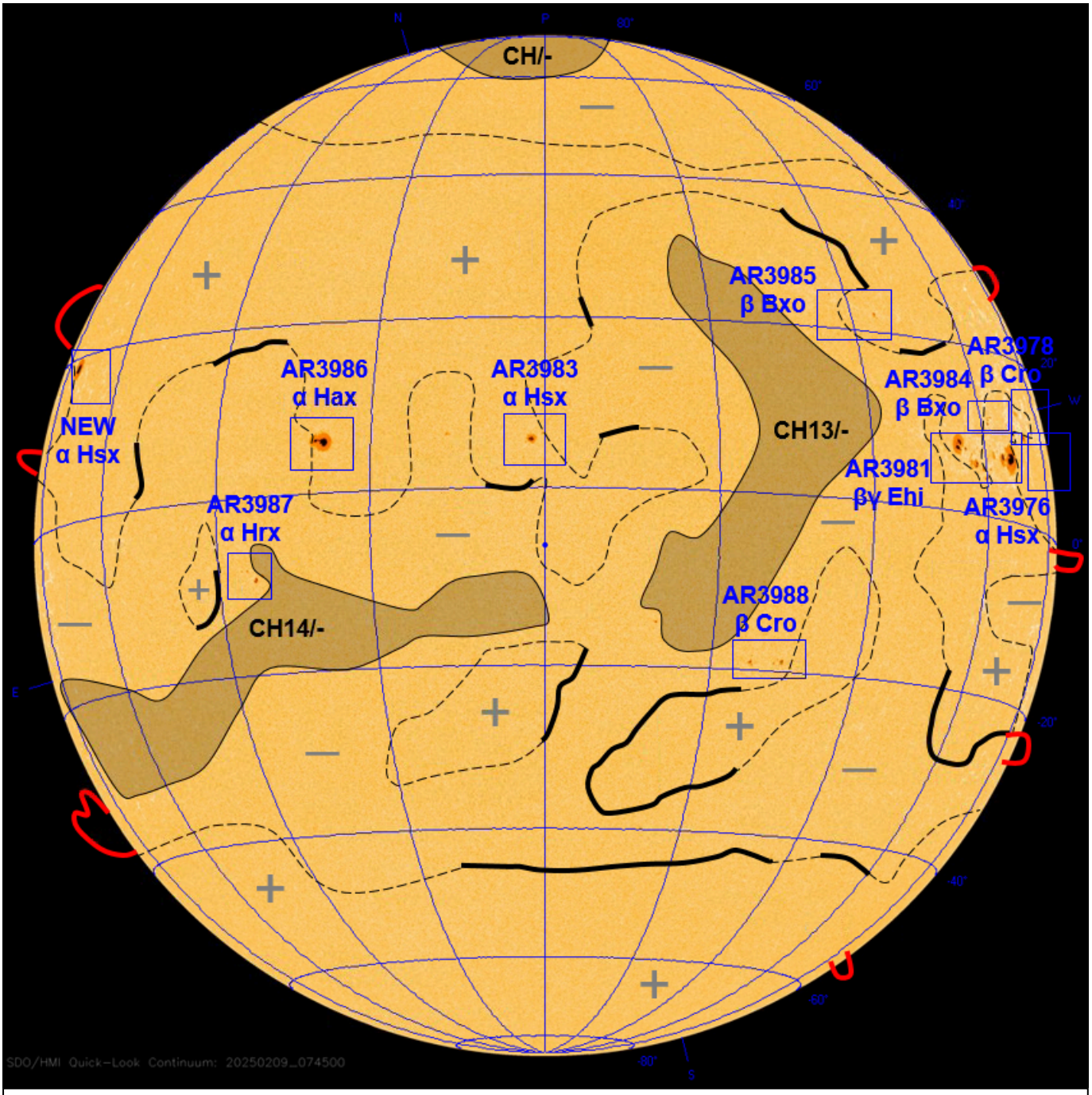
Quiet to Unsettled (Kp 0-2) geomagnetic activity is likely to increase through Day 1 (09 Feb) due to a connection to the HSS from CH13, becoming Active to G1/Minor storm (Kp4/5) with a slight chance of G2/Moderate storm intervals (Kp6). Through the rest of the guidance period activity likely continuing at Active to G1/Minor storm levels, with the combined risk of the CME arrival on Days 2-3 (10/11 Feb and a subsequent potential connection to a HSS from CH14 by Day 3-4 (11/12 Feb).

Energetic Particles / Solar Radiation: There is a slight chance of S1/Minor radiation storm events as the cluster of sunspots in the northwest are now in a good position to connect with Earth, should there be further large flares. High energy electron flux observed at GOES16 is expected to be mostly at background levels, with a probable rising trend on Days 3 and 4 (11-12 Feb). The corresponding 24 hour fluence is likely to persist below the Active threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 1: Solar Synoptic Map Valid 09/0745 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Geomagnetic Storms

There is a slight chance of up to two glancing blows from faint CMEs associated with two M7 flares on 06/07 Feb, which may arrive at Earth late on Day 2 (10 Feb) and into the early hours of Day 3 (11 Feb). A third slow CME left the Sun around 08/0930 UTC in association with the M2.0 flare from AR3981, given its slow speeds, it is currently thought that it will get absorbed into the HSS with little defined impact to Earth.

Solar winds are currently showing a rising trend, up to 410km/s at the time of writing. This is expected to continue to rise today (09 Feb) as we see a connection to the high speed stream from CH13/-. This feature appears to be larger and more intense compared to the previous rotation, when speeds reached around 450 km/s. On this rotation solar winds are expected to become elevated to potentially strong at 500-600 km/s, in line with MOSWOC Enlil expectations. However, Enlil is too early in its onset of the HSS arrival at Earth. This is expected to be shortly followed by a connection to a HSS from CH14/-, again a recurring feature with solar winds becoming Elevated to Strong.

Quiet to Unsettled (Kp 0-2) geomagnetic activity is likely to increase through Day 1 (09 Feb) due to a connection to the HSS from CH13, becoming Active to G1/Minor storm (Kp4/5) with a slight chance of G2/Moderate storm intervals (Kp6). Through the rest of the guidance period activity likely continuing at Active to G1/Minor storm levels, with the combined risk of the CME arrival and a subsequent potential connection to a HSS from CH14 by Day 3/4 (11/12 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	60	60	50
Strong	G3	No	5	5	10	5
Severe	G4	No	1	1	1	0
Extreme	G5	No	1	1	1	0

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
07/0200	Partial	AR3981	NW	300	10/2100 +/-12 hours	Low confidence.
07/2100	Partial	AR3981	NW	300	11/0000 +/-12 hours	Low confidence.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 2: MOSWOC Enlil output, showing the HSS onset too early compared to reality.

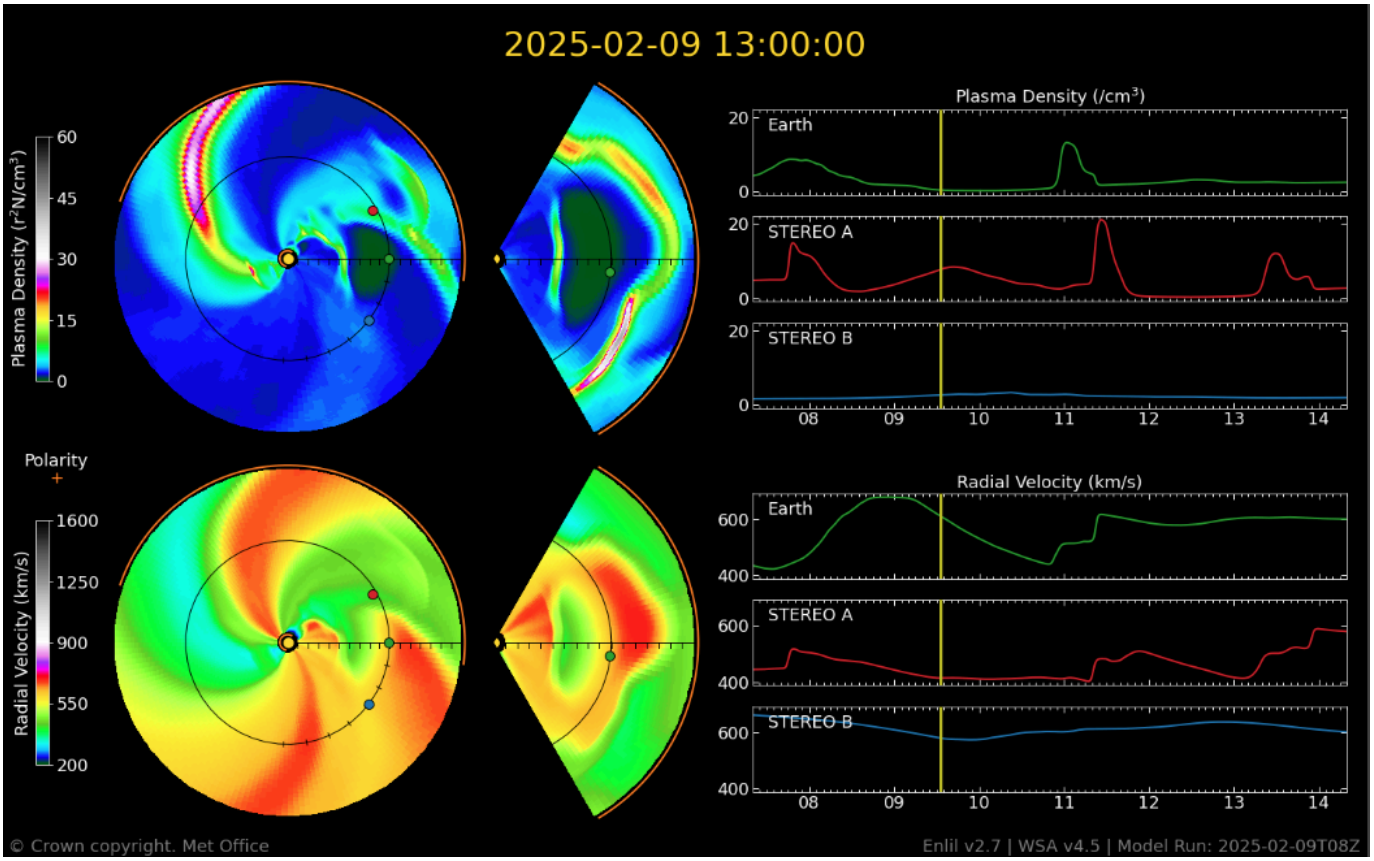
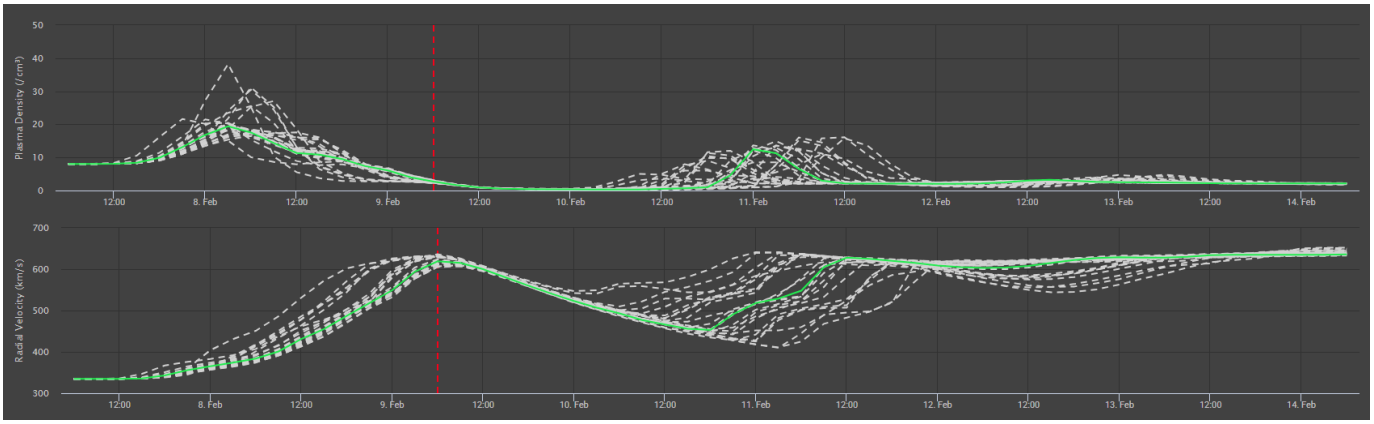
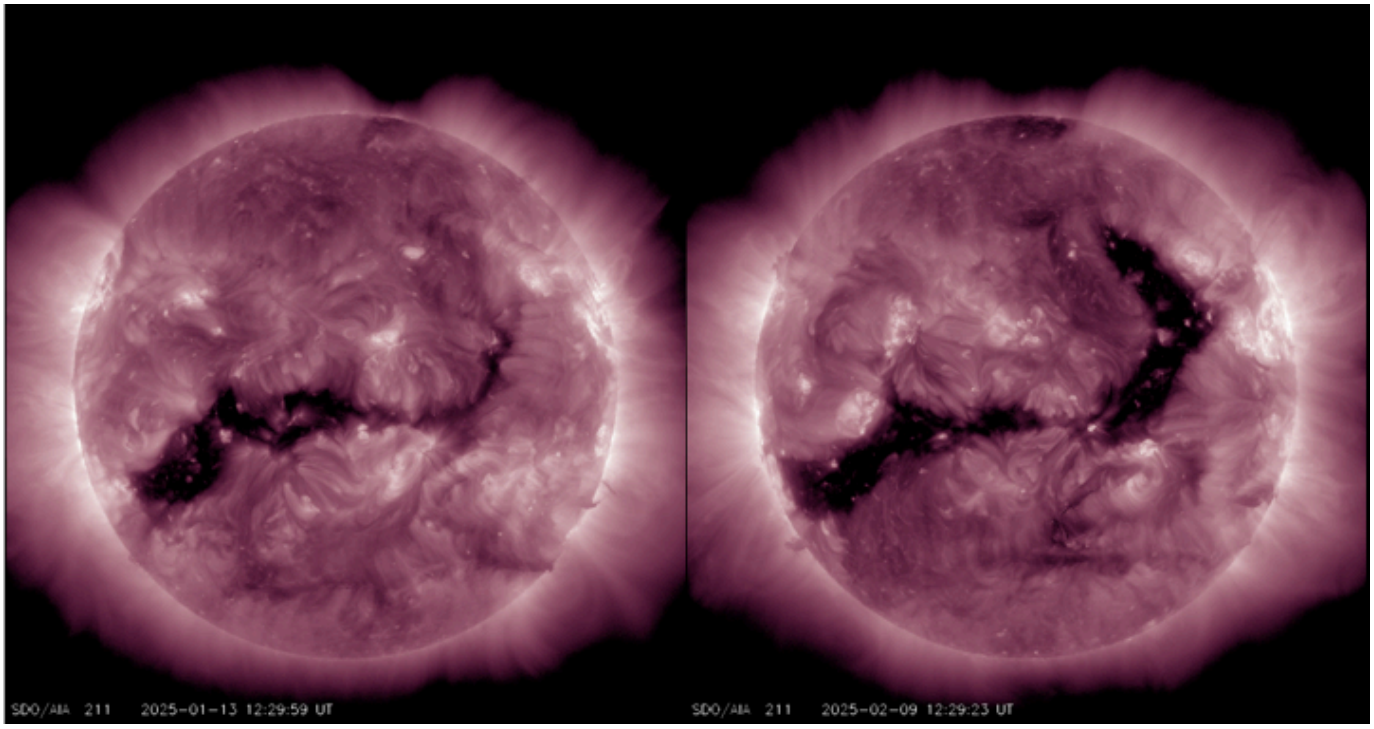


Figure 3: MOSWOC Ensemble data showing the spread of arrival times for a CME on 10/11 Feb.



© Crown Copyright 2025. All Rights Reserved.

Figure 4: SDO/AIA 211 imagery. Left showing the previous rotation (13 Jan) on the right, the current roation (09 Feb). Notably larger recurrence of the central CH.



© Crown Copyright 2025. All Rights Reserved.

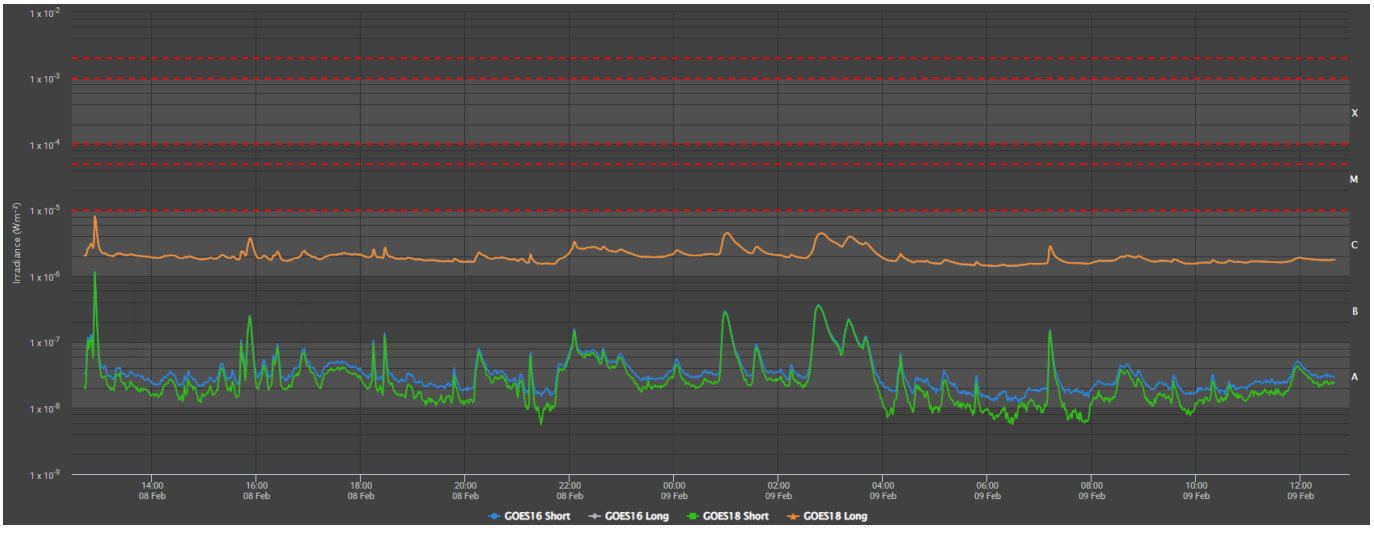
Radio Blackouts - X-Ray Flares

Ten active regions cover the Earth-facing disc. A cluster of entwined regions exists in the northwest quadrant, containing AR3976, AR3978, AR3981 and AR3984. These four regions continue to mostly show slow decay in recent hours. The largest and most complex region is AR3981 with the recent loss of its remaining delta spot in the intermediate portion. Further reorganisation of the intermediate spots was observed. The other regions within this cluster are close together and rather ill-defined with respect to their boundaries and appear magnetically interconnected. Remaining regions on the disc are relatively small and simple. The new unnumbered region continues to rotate into view from the northeast limb and visible plage to on the southeast limb indicating further regions likely to rotate on to the Earth-facing disc in the next 24-48 hours.

Solar activity is currently low with only C-class flares in the last 24 hours, mainly from the cluster of spots in the northwest. M-class flares are likely, with a slight chance of an isolated X-class flare. While AR3981 will begin to rotate of the western limb from the end of Day 2 (10 Feb), SDO/AIA 171 imagery shows notable looping around the eastern limb and combined with far-sided data suggests several complex regions are soon to appear. As a result the forecast probabilities of significant flares, in the table below, show a slight increase in probabilities from Day 3 (11 Feb).

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	70	70
Very Active	R3-R5 (X Class)	No	10	10	20	20

Figure 5: X-ray flux trace from GOES 16&18 over the last 24 hours.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

The northwestern cluster of sunspots, including AR3981, is in a favourable position to connect with Earth and produce an increase in proton flux following any large flares. That said, none of the more notable flares have so far proven proton-rich, therefore the overall risk is remained at a slight chance of reaching above the S1/Minor radiation storm threshold throughout the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

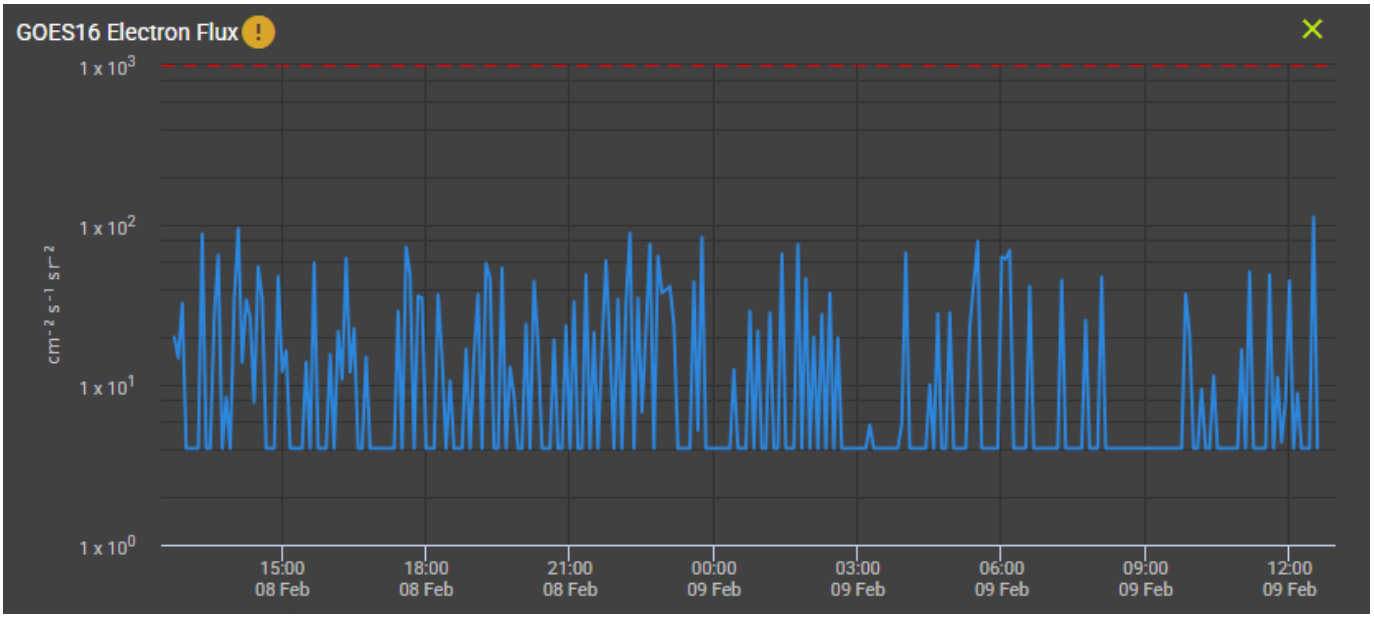
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been at background levels. The imminent arrival of the High Speed stream (HSS) related to CH13/-, is likely to give an eventual significant response in charging of the Van-Allen belts but this may not start until the end of the guidance period. Possible CME arrivals in the interim complicate this picture, but overall mostly background electron flux is expected until later in the period when high levels are more likely at the diurnal peak.

The corresponding 24-hour fluence is expected to persist below the Active threshold through much of this guidance period, with a rising trend through Days 3 and 4 (11-12 Feb). MOSWOC REFM output shows levels below Active. However this may be underperforming later in the period given the more marked appearance of CH13/- and probabilities of a breach are raised for the fluence alert to be activated by Day 4 (12 Feb).

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	10	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	5

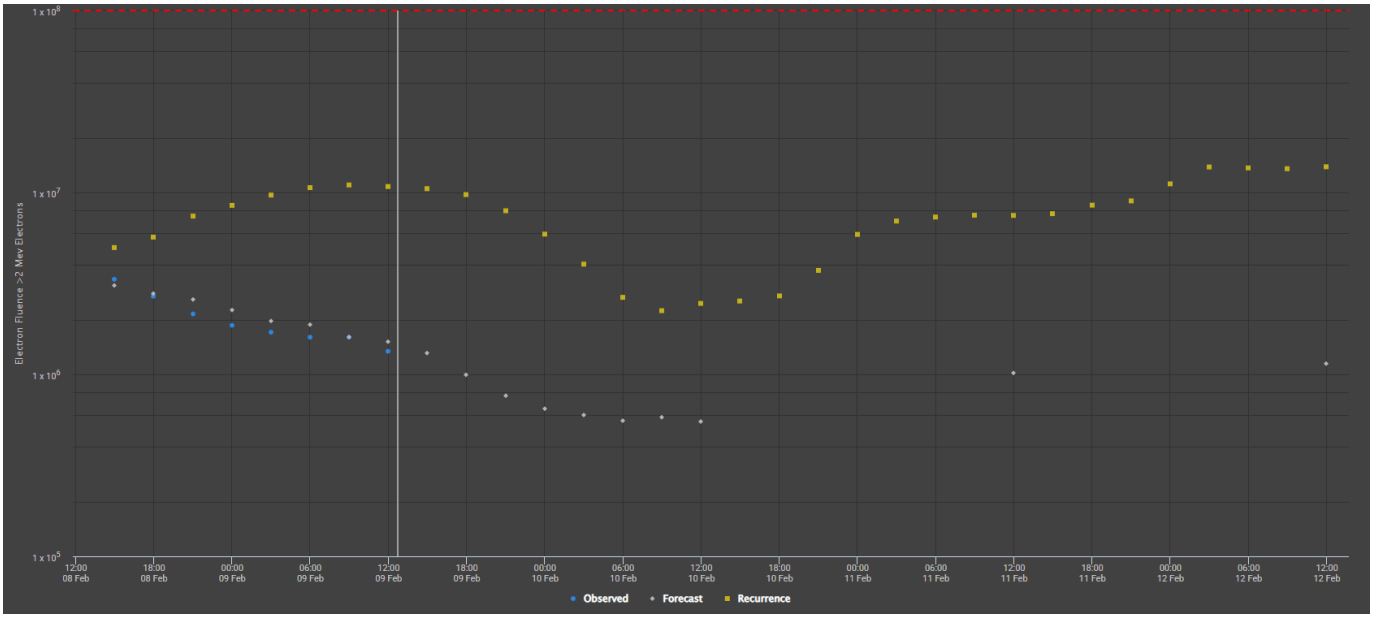
Figure 6: GOES16 Electron flux.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 7: MOSWOC REFM output showing an initially declining trend before rising, staying below the active threshold throughout.



© Crown Copyright 2025. All Rights Reserved.